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GPPR - A MULTIPURPOSE COMPUTER CODE FOR DATA PLOTTING

M. J. Caddy
Air Vehicle Technology Department
NAVAL AIR DEVELOPMENT CENTER
Warminster, Pennsylvania 18974

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I N T R O D U C T I O N

The NAVAIRDEVVCEN (Naval Air Development Center) is a large user of vehicle and propulsion design and performance computer codes. A significant number of these programs is dependent on the use of input tabular data sets. Experience has shown that it is desirable to have a visual representation of these data sets prior to use in these programs to avoid employing incorrect data. In addition, the programs often require a means of expressing output results in a form other than digital data. This present report describes a general purpose routine which will generate data plots in terms of one or two independent variables. This code, entitled GPPR (General Purpose Plotting Routine) for plotting data, was developed for the NAVAIRDEVVCEN CDC 6600/CYBER 175 computer facilities and is used in conjunction with a model 735 CALCOMP pen plotter. A user's guide for this code is shown in Appendix A. A sample problem is illustrated in Appendix B and a FORTRAN code listing is given in Appendix C.

D I S C U S S I O N

CODE DESCRIPTION

The GPPR code was developed as a computer tool to permit users to easily and quickly plot digital data for both use in reports and editing of table data sets used as inputs in other computer codes. A completely general plotting routine was thought to be awkward and inconvenient to the user, because of the large numbers of inputs that would be required. For this reason decisions were made which restrict the options related to the plot size and axis labeling. The code package consists of subroutines GPPR, AXSCALE, and function SPLNQL. A user written main program is required to use the plot package. An example of a main program is shown in Appendix C.

The basic features and options selected for the GPPR subroutine are as follows:

Plot Size

The standard size GPPR plot is 8.5 by 11 inches which is compatible with present NAVAIRDEVVCEN report page size. The manner in which these plots are produced on the CALCOMP Pen Plotter is shown in Figure 1. The entire plot size (all symbols, scales, and other characters) may be changed from the standard size through an input size factor. For example plots of 4.25 by 5.5 inches would be obtained with an input size factor equal to .5.

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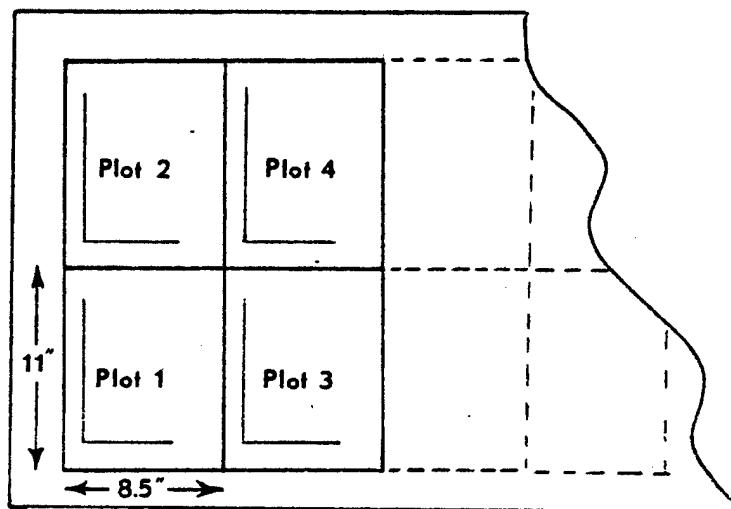


FIGURE 1. GPPR OUTPUT FROM CALCOMP PEN PLOTTER

Titles, Axis Labeling and Increment Size

The standard size axis lengths are 5 and 7 inches, respectively, with tic marks provided at one inch intervals. The scale and increment size for each axis is determined from another subroutine, AXSCALE. The AXSCALE routine determines the largest scale and increment size that will permit all data points to lie within the boundary, .01 inch less than the start of and .05 inch greater than the end of each axis. The AXSCALE routine will select the correct scale and increment size in multiples of 1, 2, or 5. This particular scale selection procedure enables the user to overlay the GPPR plot with 10 divisions per inch graph paper and accurately read values from the GPPR plot. For example, if y axis values ranged from 0 to 200, the axis label values would be 50 units per inch with a full scale value of 350. A FORTRAN listing of the AXSCALE code is found in Appendix C.

Each axis title label is input by the user. A title label option for a second independent variable is also provided. Each line of the main title heading is automatically centered over the plot. The entire main title heading may contain a maximum of four lines with no more than 35 characters per line.

Data Presentation

The GPPR routine has three options concerning presentation of data on each plot.

1. Option 1

The first option is to plot symbols for each input data point. If two or more second independent variables are input then different type symbols will be used for each group of points representing a constant value of the second independent variable.

2. Option 2

The second option is an extension of the first option. The symbols are plotted as in option 1 and an in-house developed cubic spline interpolation code, function SPLNQ1, based on methods in reference (a), is used to draw a smooth curve between each set of symbol types. The cubic spline interpolation technique is unique in that the interpolated curve passes through each data point and has continuous first and second derivatives. A FORTRAN code listing for function SPLNQ1 is given in Appendix C.

3. Option 3

The third option permits the user to plot the interpolated spline curve with symbols appearing only at each end of the spline curve. The symbols at the end of each spline curve are retained only to identify each curve in terms of the associated second independent variable value.

4. Grid Option

The grid option permits a 1 inch grid to be drawn at the tic marks on the axes. Instructions for using these options are given in Appendix A.

C O N C L U S I O N S A N D R E C O M M E N D A T I O N S

The general purpose plotting routine discussed in this report is a valuable computer based tool. The GPPR subroutine is flexible and easily incorporated into new or existing computer codes.

The present structure of GPPR restricts usage to curves with open arcs and single values of the dependent variable at each independent variable. It is recommended that program development proceed which will extend GPPR to permit the plotting of data which can be the form of a closed arc.

R E F E R E N C E S

- (a) Pennington, Ralph H., "Introductory Computer Methods and Numerical Analysis", Macmillian Company, London, 1970

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APPENDIX A
USER'S GUIDE

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APPENDIX A
USER'S GUIDE

All inputs into the GPPR routine are passed as formal parameters in the call statement to GPPR. The order of the parameters in the call statement is as follows:

```
CALL GPPR (NPLOT, LABY, N1, LABX, N2, LABTL, NT, X, Y, NPTS, LABVAL,  
NCC, VLABL, NDECV, ITIP, IGRID, FAC)
```

These parameters are defined as follows:

NPLOT is an initializing parameter which is set to 0 before the first call to GGPR. NPLOT is only set once.

LABY is an array containing the Hollerith data for the Y axis label.

N1 is the number of elements in the LABY array comprising the Y axis label. (1 element = 10 characters)

LABX is an array containing the Hollerith data for the X axis label.

N2 is the number of elements in the LABX array comparisons for the X axis label (1 element = 10 characters).

LABTL is an array containing the Hollerith data for the main title label. Groups of 3 or more consecutive blank characters between non blank characters indicate the beginning of a new line in the title label. Space limitations permit a maximum of 4 lines with approximately 35 characters per title line. If the user attempts to use a title line longer than 35 characters, the line will terminate at the next blank after the thirty-fifth character in that line. Leading and trailing blank characters for each line are ignored and each line of title is centered on the plot.

NT is the number of elements in the LABTL array comprising the main title label (all lines) (1 element = 10 characters). If NT is equal to 0, no main title is written.

X is an array containing the X axis values of data for the entire plot. For example, consider a plot with three curves to be drawn as shown in Figure A-1. If the first curve has 6 data points and the second curve has 4 data points, then elements X(1) to X(6) are the X axis coordinate values for the first curve and elements X(7) to X(10) are the X axis coordinate values of the second curve. The third curve points would follow in X(11) to X(15). The order of the 6 points in the X array comprising the first curve is unimportant. Similarly, the order of the points comprising any curve is unimportant.

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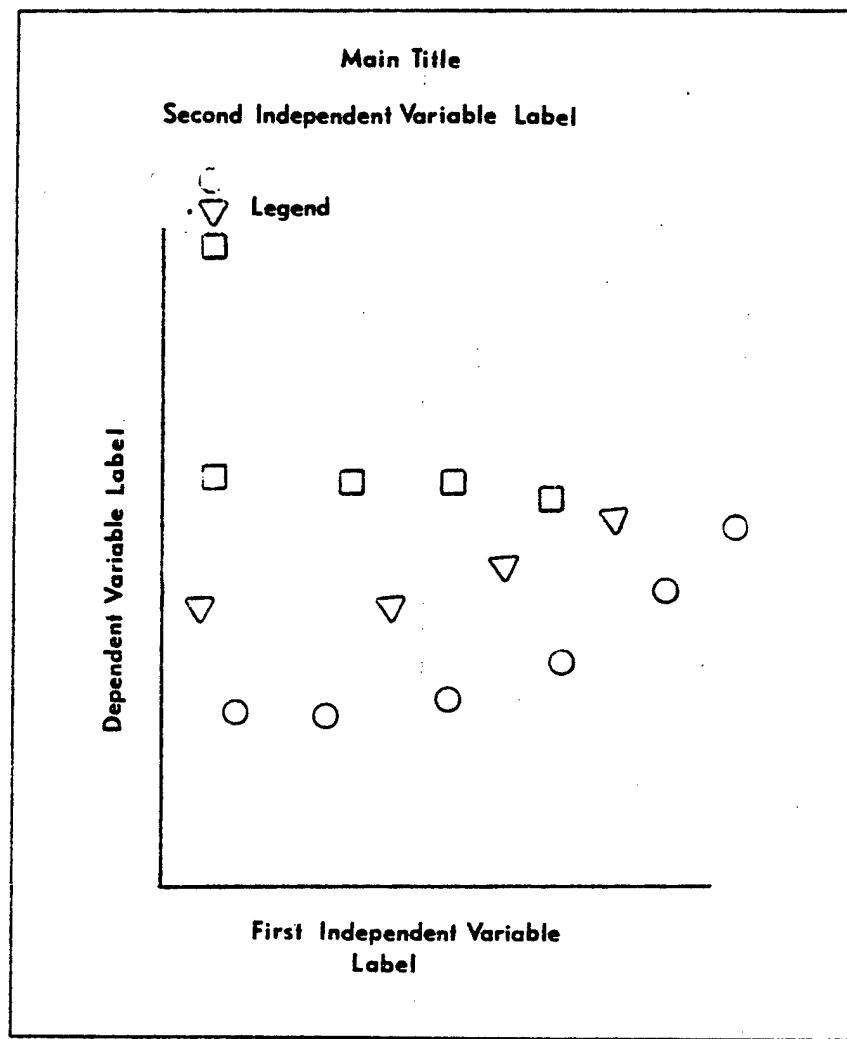


FIGURE A-1. GPPR EXAMPLE PLOT OPTION 1

Y is an array containing the Y axis values of data for the entire plot. There must be a one to one correspondence between the Y array values and the X array values. For example, X(1) and Y(1) are the X and Y axis coordinate values of the first input data point.

NPTS is an array containing the number of data points for each curve on the plot. In the preceding example, NPTS (1) = 6, NPTS (2) = 4, and NPTS (3) = 5. The NPTS element following the last element used to identify the last curve must be set equal to zero. In this example, NPTS (4) must be set equal to 0.

LABVAL is an array containing the Hollerith data for the second independent title label. This title label is used identify the value held constant for each curve on the plot. (1 element of the array will contain 10 characters.)

NCC is the number of elements in the LABVAL array comprising the second independent variable (if NCC = 0 no second independent variable title is generated on the plot) title label (1 element = 10 characters).

VLBL is an array containing the values of the second independent variable associated with each curve. The first element of VLBL is associated with the first set of points in the X and Y arrays. If NCC is set equal to zero then VLBL is not applicable.

NDECV is the number of significant figures to the right of the decimal for the VLBL array to be used on the plot.

ITIP is a switch used to indicate the following options.

<u>ITIP</u>	<u>OPTION</u>
1	plot symbols only
2	plot symbols and draw a spline curve fitted with respect to X axis
3	same as ITIP = 2 except symbols are only plotted at end points of spline curve
-2	plot symbols and draw a spline curve fitted with respect to Y axis
-3	same as ITIP = -2 except symbols are only plotted at end points of the spline curve

IGRID is a switch used to indicate grid options. If IGRID = 1, a one inch grid is drawn on the plot. Otherwise, no grid is drawn.

FAC is a value indicating the size factor of the plots. FAC set to 1.0 is the standard size indicating plots 8.5 by 11 inches will be drawn.

The last step in any program using the GPPR subroutine is to end the plotting tape. To end the plotting tape the user must enter a call to GPPREND using the same formal parameters previously defined in the call to the GPPR subroutine.

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APPENDIX B

SAMPLE PROBLEM

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APPENDIX B
SAMPLE PROBLEM

In this appendix an example problem using the GPPR subroutine is illustrated. In this example, a 2 independent variable function is plotted, standard size. In order for the user to implement the plotting package, data must be input into the GPPR subroutine from another program or subroutine. In this example, program EXPLOT is the means by which the plot inputs are transferred into the GPPR subroutine. In Appendix C the FORTRAN listings of program EXPLOT and the other routines forming the plotting package (GPPR, AXSCALE, and SPLNQ1) are shown. On cards 3 and 4 of EXPLOT (see page C-2), the input data points (X is the first independent variable, Y is the dependent variable) are set using a DATA card statement. The NPTS array is set to 7, 5, and 0 on card 6 indicating two curves are input. The first curve has 7 points (X and Y array elements 1-7) and the second curve has 5 points (X and Y array elements 8-12). The elements of the second independent variable array are set on card 5, page C-2, to values .5 and .821 respectively. The axis labels, main title label and second independent variable label are set on cards 7 through 11, page C-2. The call to the GPPR subroutine is shown on card 12. Most of the formal parameters have been defined above. The remaining parameters are defined with numerical values in the call statement to GPPR indicating the following:

The Y axis label has 2 elements

The X axis label has 2 elements

The main title label has 6 elements

The second independent variable label has 3 elements

The values of the Z array on the plot will have 3 significant figures to the right of the decimal

The plot will be standard size with symbols, spline curve, and grid drawn

The resulting plot generated from the CALCOMP Pen Plotter is shown in Figure B-1. The computer time required to generate the CALCOMP Pen Plotter instructions for this problem was about .6 CP (Central Processor) seconds.

EXAMPLE GPPR
PLOT
TWO INDEPENDENT VARIABLES
X AND Z

SECOND INDEPENDENT VARIABLE

▲ 0.500
○ 0.821

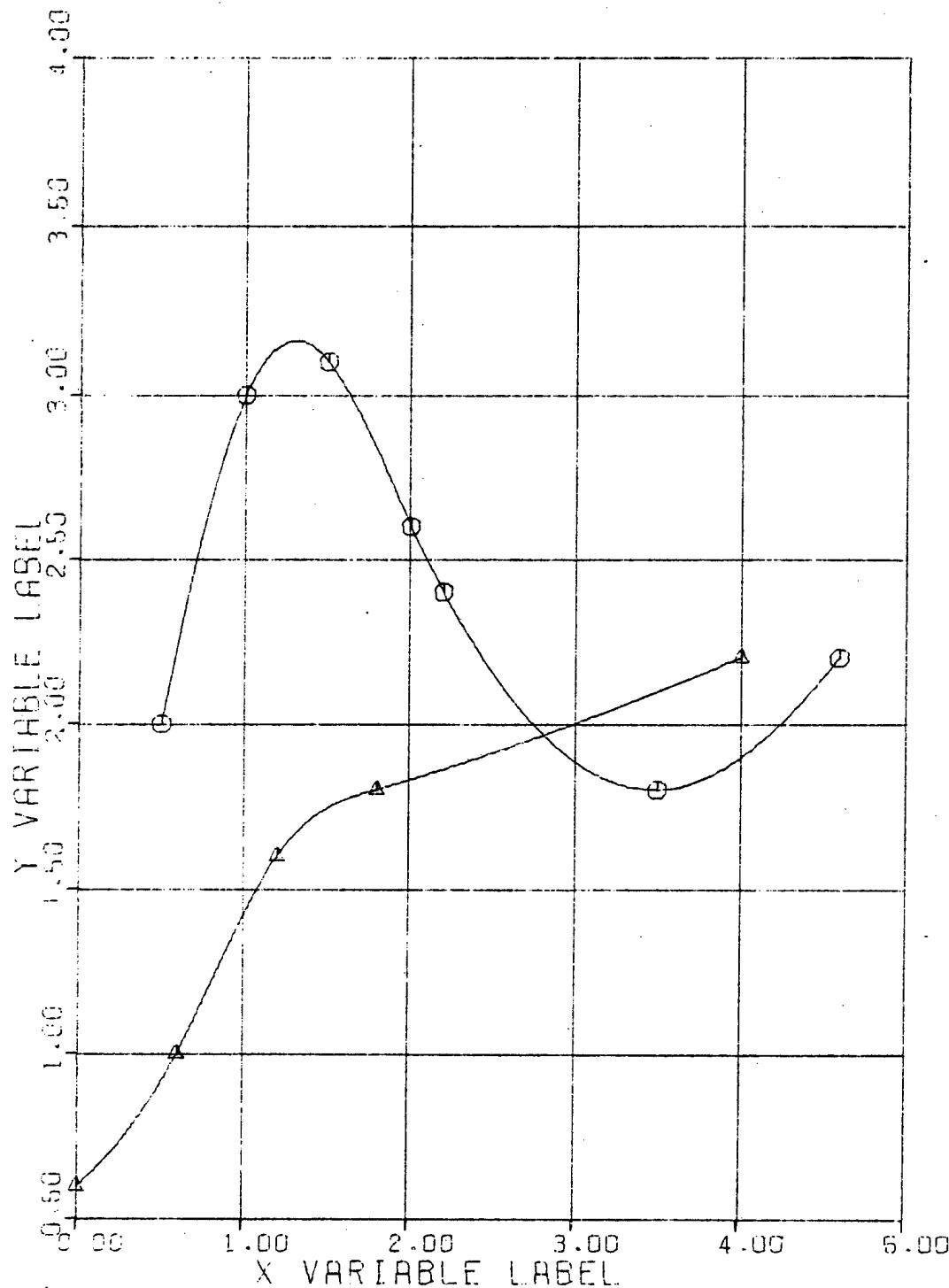


FIGURE B-1. EXAMPLE GPPR PLOT

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APPENDIX C

PROGRAM LISTING

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PROGRAM EXPLOT

```

PROGRAM EXPLOT(INDPUT,OUTPUT,TADPFI)
DIMENSION X(100),Y(100),Z(4),NPTS(5),IYT(3),IT(R),IZT(3)
DATA X/1.0,2.0,2.0,2.0,2.0,2.0,2.0,2.0,2.0,2.0/
DATA Y/1.0,2.0,2.0,2.0,2.0,2.0,2.0,2.0,2.0,2.0/
DATA Z/1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0/
DATA NPTS/7.5.0/
DATA IYT/10H VARTAFLF.10H LAFFL /
DATA ITY/10H VARTABLE.10H LARFL /
DATA IT/10H FXAMP F G.10H PDP PIOT.10H TWO IND.10H PENDNT V.
10H PTAFLS .10H V ANN 7 /
DATA IZT/10H SECOUN 14.10H PFPENDNT .10H VARIABL /
CALL GDPP (NDLT,IYT,2,IYT,2,IT,6,X,Y,NPTS,IZT,3,Z,3,2,1,1,0)
CALL GDPP (NDLT,IYT,2,IYT,2,IT,6,X,Y,NPTS,IZT,3,Z,3,2,1,1,0)
END

```

SUBROUTINE GPPR

```

      SUBROUTINE GPPR(NP1,01,LARY,N1,IARY,M2,LANTL,NT,X,Y,
     1 NPTS,LARVAL,NCC,V1,AEL,MFCV,TIP,TGPIN,FAC)
C *** GFNEPDL PIRSONSF PLOTTING ROUTINE
C *** M RANDY AYD
      DIMENSION X(50),Y(50),LAUX(5),IARY(5),LAHTL(9),NPTS(30),VLARI(6),
     1 LARVAL(6),DATA(1024),N(101),NA(100),NS(303),
     2 DIMENSION I7(10),RD(80),
     3 IFIT=0
      ITYP=TTIP
      IF (ITYP.GT.0) GO TO 10
      ITYP=-TTYP
      IFIT=1
      10 NY=NJ*10
      NX=NP2*10
      NCL=NC*10
      NTI=NT
      IF (NPLNT.NE.0) GO TO 20
      CALL PLNTS(DATA,1024,1)
      CALL FACTOR(FAC)
      GO TO 60
      20 IF (FAR.GT.1.0) GO TO 50
      GO TO (30,40),NPLNT
      30 CALL PLNT(0.,11.0,-3)
      GO TO 60
      40 CALL PLNT(8.5,-11.0,-3)
      NP1,0T=0
      GO TO 60

```

GPPR (CONTINUED)

```

50 CALL PLOT(8.5,0.0,-2)
60 NPI NT=NPI+1
   Y1=R.75
   K1=1
   NTI S=1
   IF(NTL .LT. 0) GO TO 160
70 ITI I=0
   NPI K=0
   DO 170 I=NTL ,NTI
      IWORD=LAPTL(I)
      DO 80 J=1,10
         IWORD=SHIFT(IWORD,A)
         IF(K1.GT.10) GO TO 130
         DO 120 K=1,10
            IF((I7(K).NE.0).LT. ) GO TO 90
            IF((ITL ).FO.0) GO TO 120
            NPI K=NPI,K+1
            IF(NRPLK.NE.2) GO TO 100
            ITI I=ITI I-2
            GO TO 140
90 NPI K=0
100 IF((ITI I.LT.25) GO TO 110
   IF((I7(K).EQ.1L ) GO TO 140
110 ITI I=ITI I+1
   IP(ITL )=V7(K)
120 CONTINUE

```

GPPR (CONTINUED)

```

130 K1=1          0055
    TT1=TT1,1-NBQL,K   0056
140 X1=(5,-.13333*ITL,1)/2. 0057
    ITL,S=1           0058
    K1=K+1           0059
150 I=150 R=1,ITL,1       0060
    JI=IP(I)          0061
    CALL SYMRL(X1,Y1,.14,.IL,0,0,1) 0062
150 X1=X1+.13333      0063
    Y1=Y1-.?1         0064
    IF(NBQL,F0,3) GO TO 70 0065
160 CALL PL0T(6.75,9.50,3) $ CALL PL0T(6.75,-1.5,2) 0066
    CALL PL0T(-1.75,-1.5,2) $ CALL PL0T(-1.75,9.50,2) 0067
    CALL PL0T(6.75,9.5,2) 0068
    NL=0              0069
    NPTOT=0            0070
170 IF(NPTS(I),F0,0) GO TO 180 0071
    NL=NL+1            0072
180 NPTOT=NPTOT+NPTS(I) 0073
    CONTINUE            0074
    IF(INCL.,F,0) GO TO 210 0075
    YW=Y1               0076
    CALL SYMRL(.5,YW,0,10,LARVAL,0,0,NCL.) 0077
    XW=.5               0078
    YW=YW-.?2           0079
    YCAYF=Y1             0080
    NCL

```

GPPR (CONTINUED)

```

100  NC=11    TC=1    ND=15
      TF(NS,GT,5)  ND=5
      NS=NS-5
      DO 200 J=1,ND
      CALL SYRDL(XW,YW,10,15,0,-1)
      XW=XW+2
      CALL MNPDFP(XV,YW,10,MLBL(TS),0,0,MDFCN)
      TS=TS+1
      YW=YW-.15
      NP=NS
      IF(NS.LF.0) GO TO 210
      CALL WHPDF(XW,YW,FAC)
      XW=XW+.5
      YW=YSAVE
      GO TO 100
100  CONTINUE
      CALL AXCALF(Y,7,MPCT,YRFATN,DFLY)
      CALL AXCALF(Y,5,MPOT,XREGIN,DFLX)
      CALL AXIS(0,0,LABY,NY,7,0,YREGIN,DELY)
      CALL AXIS(0,0,LAPX,-1,XREGIN,DELY)
      IF(ITYP,NF,1) GO TO 230
      J=n
      DO 220 T=1,NT
      NDT=NPT(J)
      DO 220 K=1,NDT
      J=J+1
      XD=(X(J)-XRFATN)/DFLX
      0082
      0083
      0084
      0085
      0086
      0087
      0088
      0089
      0090
      0091
      0092
      0093
      0094
      0095
      0096
      0097
      0098
      0099
      0100
      0101
      0102
      0103
      0104
      0105
      0106
      0107
      0108

```

GPPR (CONTINUED)

YDP=(Y(J)-YREFIN)/REFY
 CALL SYMOUT(XDP,YP,10,10,0,-1)
 COUNTNMF
 220 GOTO 420 I=1+NLL
 230 NMLV=-1
 NC=0
 DO 420 I=1+NLL
 411 GOTO 420 I=1+NLL
 412 NC=NIC
 413 NDT=NPTC(1)
 414 NC=NIC+NPT
 415 DO 240 I=1,100
 416 NAL(I)=I+15
 417 IF (NDT-1)300.300.250
 418 NDNMF=1
 419 K1=NAL(I-1)
 420 K2=NAL(I)
 421 IF (NDT-1)280.290.270
 422 IF (X(K1)-X(K2))280.290.270
 423 IF (Y(K1)-Y(K2))280.290.270
 424 IF (FIT.FG,0,1)270
 425 NDNMF=1
 426 K2=K1
 427 NAL(I-1)=K2
 428 NDNMF=0
 429 COUNTNMF
 430 IF (NDCNMF)250,250,270
 431 NAL(I)=NAL(NDT)
 432 NDT=NPT-1
 433 NDNMF=0
 434 IF (NDCNMF)250,250,270
 435 NAL(I)=NAL(NDT)
 436 NDNMF=1
 437 NAL(I)=K1
 438 NDNMF=0
 439 COUNTNMF
 440 NAL(I)=NAL(NDT)
 441 NDNMF=1
 442 NAL(I)=K2
 443 NDNMF=0
 444 COUNTNMF
 445 NAL(I)=NAL(NDT)
 446 NDNMF=1
 447 NAL(I)=K1
 448 NDNMF=0
 449 COUNTNMF
 450 NAL(I)=NAL(NDT)
 451 NDNMF=1
 452 NAL(I)=K2
 453 NDNMF=0
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 507 NAL(I)=K1
 508 NDNMF=0
 509 COUNTNMF
 510 NAL(I)=NAL(NDT)
 511 NDNMF=1
 512 NAL(I)=K2
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 515 NAL(I)=NAL(NDT)
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 521 NDNMF=1
 522 NAL(I)=K2
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 527 NAL(I)=K1
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 532 NAL(I)=K2
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 537 NAL(I)=K1
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 539 COUNTNMF
 540 NAL(I)=NAL(NDT)
 541 NDNMF=1
 542 NAL(I)=K2
 543 NDNMF=0
 544 COUNTNMF
 545 NAL(I)=NAL(NDT)
 546 NDNMF=1
 547 NAL(I)=K1
 548 NDNMF=0
 549 COUNTNMF
 550 NAL(I)=NAL(NDT)
 551 NDNMF=1
 552 NAL(I)=K2
 553 NDNMF=0
 554 COUNTNMF
 555 NAL(I)=NAL(NDT)
 556 NDNMF=1
 557 NAL(I)=K1
 558 NDNMF=0
 559 COUNTNMF
 560 NAL(I)=NAL(NDT)
 561 NDNMF=1
 562 NAL(I)=K2
 563 NDNMF=0
 564 COUNTNMF
 565 NAL(I)=NAL(NDT)
 566 NDNMF=1
 567 NAL(I)=K1
 568 NDNMF=0
 569 COUNTNMF
 570 NAL(I)=NAL(NDT)
 571 NDNMF=1
 572 NAL(I)=K2
 573 NDNMF=0
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 575 NAL(I)=NAL(NDT)
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 577 NAL(I)=K1
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 580 NAL(I)=NAL(NDT)
 581 NDNMF=1
 582 NAL(I)=K2
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 585 NAL(I)=NAL(NDT)
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 590 NAL(I)=NAL(NDT)
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 602 NAL(I)=K2
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 605 NAL(I)=NAL(NDT)
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 607 NAL(I)=K1
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 609 COUNTNMF
 610 NAL(I)=NAL(NDT)
 611 NDNMF=1
 612 NAL(I)=K2
 613 NDNMF=0
 614 COUNTNMF
 615 NAL(I)=NAL(NDT)
 616 NDNMF=1
 617 NAL(I)=K1
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 619 COUNTNMF
 620 NAL(I)=NAL(NDT)
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 622 NAL(I)=K2
 623 NDNMF=0
 624 COUNTNMF
 625 NAL(I)=NAL(NDT)
 626 NDNMF=1
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 631 NDNMF=1
 632 NAL(I)=K2
 633 NDNMF=0
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 637 NAL(I)=K1
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 642 NAL(I)=K2
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 645 NAL(I)=NAL(NDT)
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 650 NAL(I)=NAL(NDT)
 651 NDNMF=1
 652 NAL(I)=K2
 653 NDNMF=0
 654 COUNTNMF
 655 NAL(I)=NAL(NDT)
 656 NDNMF=1
 657 NAL(I)=K1
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 659 COUNTNMF
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 661 NDNMF=1
 662 NAL(I)=K2
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 667 NAL(I)=K1
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 692 NAL(I)=K2
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 695 NAL(I)=NAL(NDT)
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 702 NAL(I)=K2
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 719 COUNTNMF
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 721 NDNMF=1
 722 NAL(I)=K2
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 725 NAL(I)=NAL(NDT)
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 730 NAL(I)=NAL(NDT)
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 742 NAL(I)=K2
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 749 COUNTNMF
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 751 NDNMF=1
 752 NAL(I)=K2
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 755 NAL(I)=NAL(NDT)
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 795 NAL(I)=NAL(NDT)
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 800 NAL(I)=NAL(NDT)
 801 NDNMF=1
 802 NAL(I)=K2
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 951 NDNMF=1
 952 NAL(I)=K2
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 955 NAL(I)=NAL(NDT)
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 965 NAL(I)=NAL(NDT)
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 969 COUNTNMF
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 975 NAL(I)=NAL(NDT)
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 978 NDNMF=0
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 980 NAL(I)=NAL(NDT)
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 984 COUNTNMF
 985 NAL(I)=NAL(NDT)
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 987 NAL(I)=K1
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 989 COUNTNMF
 990 NAL(I)=NAL(NDT)
 991 NDNMF=1
 992 NAL(I)=K2
 993 NDNMF=0
 994 COUNTNMF
 995 NAL(I)=NAL(NDT)
 996 NDNMF=1
 997 NAL(I)=K1
 998 NDNMF=0
 999 COUNTNMF
 1000 NAL(I)=NAL(NDT)
 1001 NDNMF=1

GPPR (CONTINUED)

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GO TO 250
 300 OS(1)=NPT
 IN 320 $m = 1 \circ NPT$
 $N = 4 + 1$
 KA=NA(M)
 L=N+NDT
 $XXD = (X(KA) - X(NET(M)) / DFI X$
 $YYD = (Y(KA) - Y(NET(M)) / DFI Y$
 $OS(N) = XXD$
 $OS(1) = YYD$
 IF (FFIT.NF, 1) GO TO 310
 $OS(N) = YYD$
 $OS(L) = XXD$
 GO TO 320
 CONTINUE
 $OS(1+1) = 0.$
 $OS(L+2) = 1.$
 $LH = NPT + 2 + 1$
 $KF = 10 + 4 * (OS(1) - OS(2))$
 NMAY=-NMAY
 IF (NMAY.LT.0) GO TO 330
 $KT = 0(2)$
 $YT = 0(NPT+2)$
 $NX = 3$
 GO TO 340

GPPR (CONTINUED)

```

340  XYNE=0(N)          0163
      YTN=0(L)          0164
      NC=N-1             0165
      CALL PLNT(XIN,YIN,2) 0166
      CALL SYMRNL(XIN,YIN,10,10,0,-1)
      IF(NPT,IF,1) GO TO 420
      NCSP=1               0167
      DO 410 M=1,KF        0168
      IF(IFIT,FO,1) GO TO 350
      XD=XIN+.025*M*WAY   0169
      YP=SPLN01(1.0S,XP)  0170
      XX=XP                0171
      GO TO 350            0172
      350  YP=YIN+.025*M*WAY 0173
      XD=SPLN01(1.0S,YP)  0174
      XY=YP                0175
      360  IF((XY-NC(NXS))**NWAY)>410,410,370
      370  XSY=0(NXS)
      NC=S=NXS+NPT         0176
      YSY=0(NYS)
      CALL PLNT(XSY,YSYD,2) 0177
      IF(ITYP,FO,3) GO TO 380
      380  CALL SYMRNL(XSY,YSYD,10,10,0,-1)
      390  NCSP=NCSP+1        0178
      NC=S=NXS+MWAY         0179
      IF(NCSP-NPT)>60,400,420
      400  IF(ITYP,FO,3) GO TO 420

```

GPPR (END)

```

410 CALL PLOT(XD,YD,2)
420 CONTINUE
430 IF(IGP1N,MF,1) GO TO 460
XH=0.
DO 440 TH=1.7
YH=TH
CALL PLOT(XH,YH,3)
XH=5.*((TH-2)*(1H/2))
440 CALL PLOT(XH,YH,2)
YH=0.
DO 450 TH=1.5
CALL PLOT(XH,YH,2)
XH=XH-1.
450 YH=7.*((TH-2)*(1H/2))
460 RFTPN
      FNTPY GOPEN
      CALL PLOT(14.,0.,0.,999)
      RETPN
END

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SUBROUTINE AXSCALE

```

      SUBROUTINE AXSCALE(X,AX1,N,XST,ART,XINC,TST17F)
C *** X-APPY OF DATA AX1-AXIS LENGTH INCHES
C *** N= NO. OF POINTS IN APPAY & XINC=INCREMENT INCH
C *** XSTART FIRST NO. ON AXIS
C *** ISITF=0 USE IN THE INCH SCALING . NOT =0 USF 20
      DIMENSION X(1),L(5)
      XMXX=XMTN=X(1) & L(1)=1  $L(2)=2 & L(3)=5  $L(4)=10 & L(5)=20
      IF (ISITF.NE.0) L(2)=4
      IF (N.L.F.1) GO TO 70
      DO 60 I=2,N
      XCHECK=X(I)
      IF (XCHECK.GT.XMAX) 20,40
      XMAX=XCHECK
      IF (XCHECK.LT.XMIN) 50,60
      XMTN=XCHECK
      CONTINUE
      70  F=(XMAX-XMIN)/AXL
      IF (F) 90,80
      F=XMAX/AXL
      J=-10
      DO 100 I=1,20
      K=10.*I*F
      IF (K) 110,100
      100  J=J+1
      110  DO 120 T=2,4
      IF (L(T).GT.K) 130,120
      120  CONTINUE
      130  XTNC=L(T-1)/10.*##
      K=XMIN/XINC

```

AXSCALE (END)

```
XSTART=XINC
XH=(XMAX-XSTART)/XINC
XL=(XMIN-XSTART)/XINC
IF(XH.GT.(XL+.05).OR.XL.LT.+.01) 140•150
140 I=I+1
      GO TO 120
150 CONTINUE
      RETURN
END
```

FUNCTION SPLNQ1

```

FUNCTION SPLNQ1 (N1 OC, X • X1 NINDFD)
C
C PUBLIC SPLINE FIT REVISED 10/21/71 M CANDY
C THIS VERSION HAS ONE OPTION WHICH WILL COMPUTE ALL OF THE SPLINE COEFFICIENTS
C AND STORED IN THE ARRAY. FOR N DATA POINTS 3*N+3
C STORAGE LOCATIONS ARE PROVIDED FOR THE DATA AND THE COEFFICIENTS
C NEW FEATURE IS QUICK LOOK-UP FOR LAGRANGE ARRAYS
C DIMENSION G(100), SQ(100), X(1)
XIN=X1 NINDFD
N1=N1 LOC
N0PTS=X(N1)
IN=N1+N0PTS
NSP1=NS+1
NSP2=NS+2
NS2=N0PTS*2+NSP1
L=X(NS2)
LCC=NS2+1
I0NDF=X(I SC)
K=1
NL=NSP1
NH=IN
NTDAP=-1
IF (N0PTS=1) 130•J30•10
10 IF (XIN-X(IN)) 30•140•20
20 NTDAP=0
GO TO 140
30 IF (XIN-X(NSP1)) 40•50•60
40 NTDAP=1
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```

SPLNQ1 (CONTINUED)

```

50 K=NSP?
50 T0 150
50 IF (L) 120,120,70
50 IF (X T0-X (K)) 80,150,100
50 NH=K
50 K=K-1
50 IF (X NH-X (K)) 110,150,100
50 NH=K
50 T0 120
50 K=(NH-NL)/2+NL
50 IF (K-NL) 90,140,90
50 Y011T=Y (NSP2)
50 T0 260
50 K=NH
50 M=K
50 X (MSP2)=M
50 N=M+N0PTS
50 IF (L#10000E) 160,160,220
50 X2=X (NSP2)
50 X3=X (NSP2)
50 X32=X3-Y2
50 Y3=X (1D+2)
50 Y32=Y3-X (1D+1)
50 G(1)=0.
50 S0(1)=-.5
50 N1=N0PTS-1

```

SPLNQ1 (CONTINUED)

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0080
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00 170 I=2. M1
J=N$P1+1
K1=J+N0PTS
X1=X2
X2=X3
X21=X32
X3=X(J)
X32=X3-Y2
Y2=Y3
Y3=X(K1)
Y21=Y32
Y32=Y3-Y2
 $W = (X3 - X1) / 3. - X21 * SP(I-1) / \kappa.$ 
SP(I)=X32/(W*\kappa.)
G(I)=(Y32/X32-Y21/X21-X21*X6(I-1)/\kappa.)^W
FM1=G(N1)/(2.+SP(N1))
IF(L)180.180,190
190 1D1=N0PTS
K0AS=N0PTS+LSC
X(K0AS)=FM1
60 TO 200
190 1D1=1D+2-M
200 D0 210 I=2. M1
EM2=FM1
FM1=G(N1)-SP(N1)*EM2

```

SPLNQ1 (END)

```

    X(N1)+L(SR)=FM1
    N1=N1-1          0082
    IF(L)>>0>>20.230 0C82
    NSM=NS2+N-N1+1   0083
    EM1=X(NSM-1)     0084
    FM2=X(NSM)       0085
    S=X(M)-X(M-1)    0086
    IF(NTDAD)>50.240.240 0087
    IX=M-NTDAD      0088
    IY=IX+NODTS     0089
    XS=XIN          0090
    XTIN=X(IY)       0091
    Z1=X(M)-XTIN    0092
    Z2=XTIN-Y(M-1)  0093
    YINIT=((FM2*Z2*Z1*FM1*Z1)/P.+ Y(N)-X(N-1))/S
    1-(FM2-FM1)*S/H.)*(YS-XIN)+X(IY)
    GO TO 260        0094
    250
    Z2=XTIN-X(M-1)  0095
    Z1=X(M)-XTIN    0096
    YINIT=(FM1*Z1*Z1*FM2*Z2*Z1/H.)/S+(X(N)/S-FMP*S/H.)*Z2
    1+(Y(M-1)/S-FM1*S/H.)*Z1  0097
    SPL(N0)=YINIT
    RFTUPN
    END              0102
                                0103
                                0104

```

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